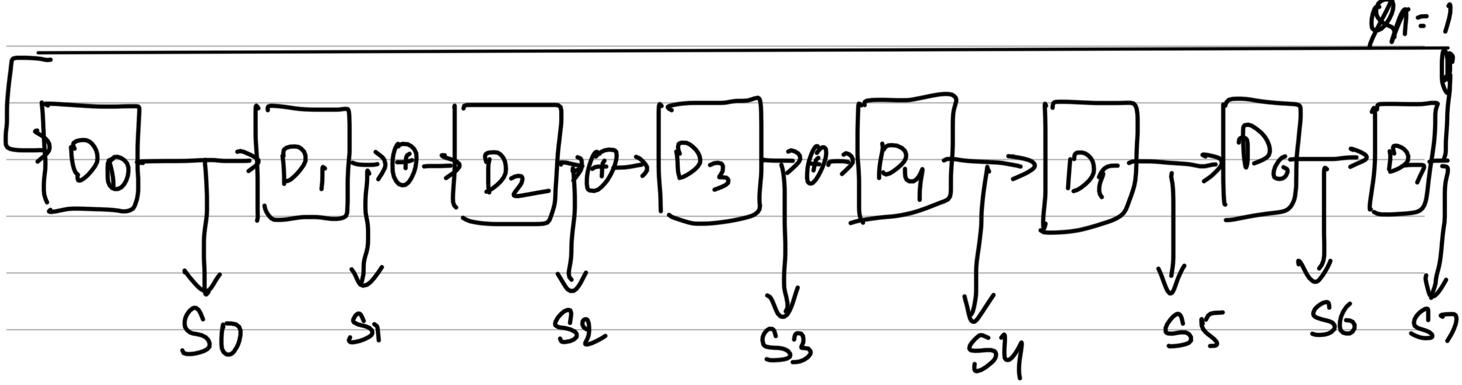
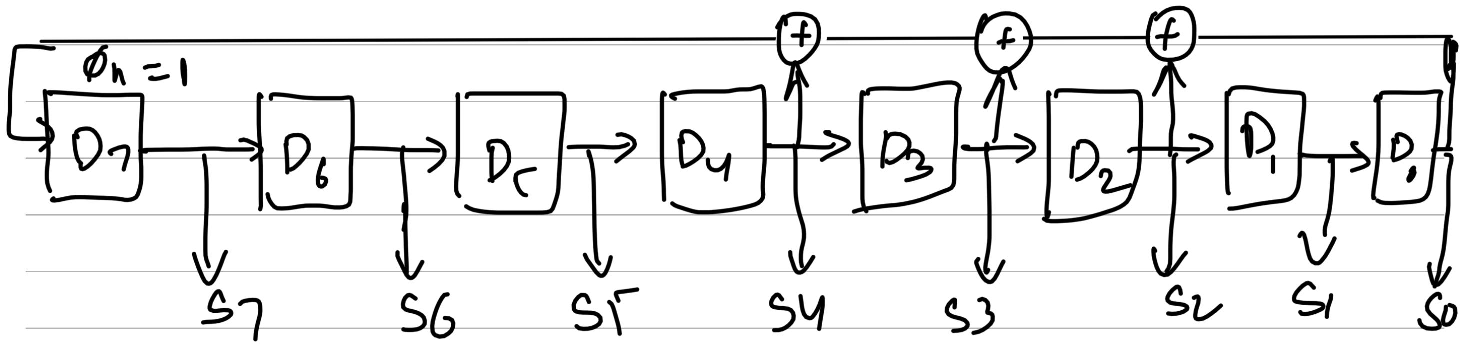
Q(2)

(i) 8-bit design for polynomial : $x^8 + x^4 + x^3 + x^2 + 1$

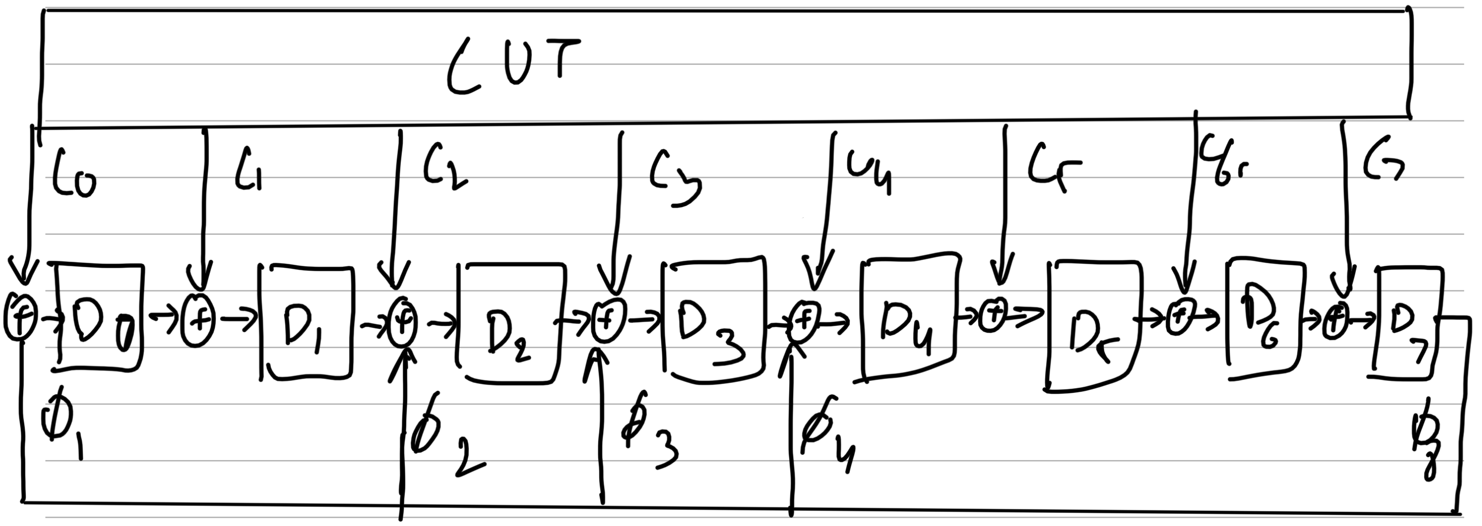
( ) Internal XOR LFSR.




(ii) External XOR LFSR.




(iii) MISR



$C_0, C_1, C_2 \ldots C_8$ are the inputs of XOR which are outputs of the circuit under test.

Table:

| | Delay | Cost |
|---|---|---|
| Internal XOR LFSR | Gates are placed depending on the feedback or polynomial | Slightly higher than External XOR LFSR |
| External XOR LFSR. | XOR gates are its feedback polynomial | higher than Internal XOR LFSR. |
| MISR | Same as the Internal XOR LFSR. | less expensive |

(ii) External - XOR LFSR.

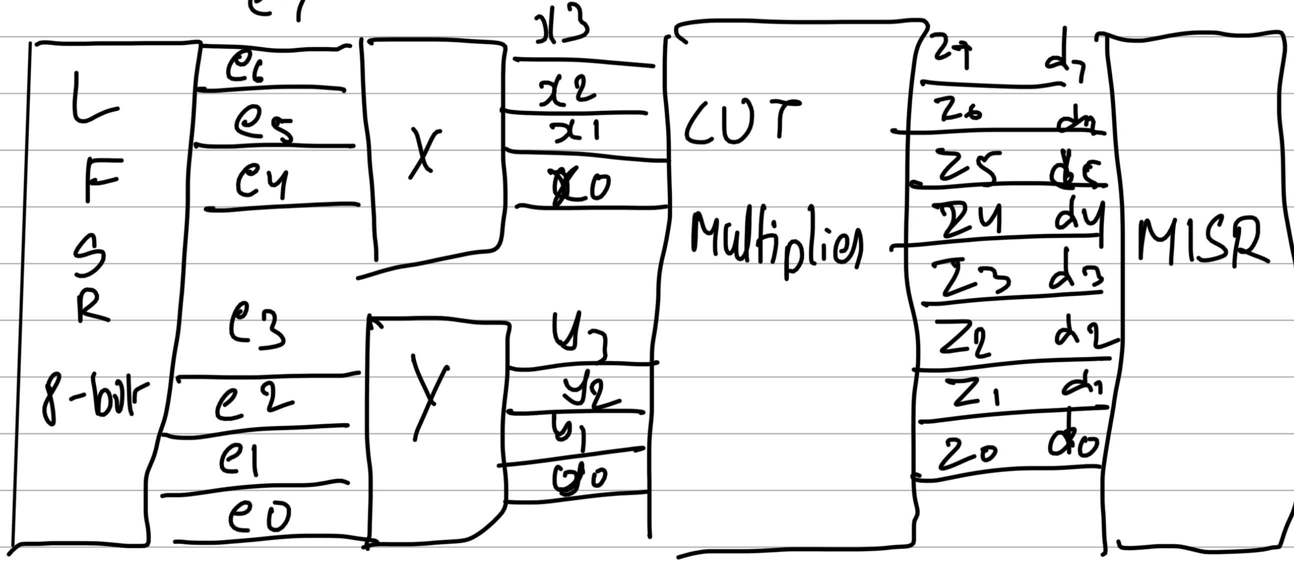
$$\begin{bmatrix} S_0(t+1) \\ S_1(t+1) \\ S_2(t+1) \\ S_3(t+1) \\ S_4(t+1) \\ S_5(t+1) \\ S_6(t+1) \\ S_7(t+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} S_0(t) \\ S_1(t) \\ S_2(t) \\ S_3(t) \\ S_4(t) \\ S_5(t) \\ S_6(t) \\ S_7(t) \end{bmatrix}$$

Initial value = 11111111

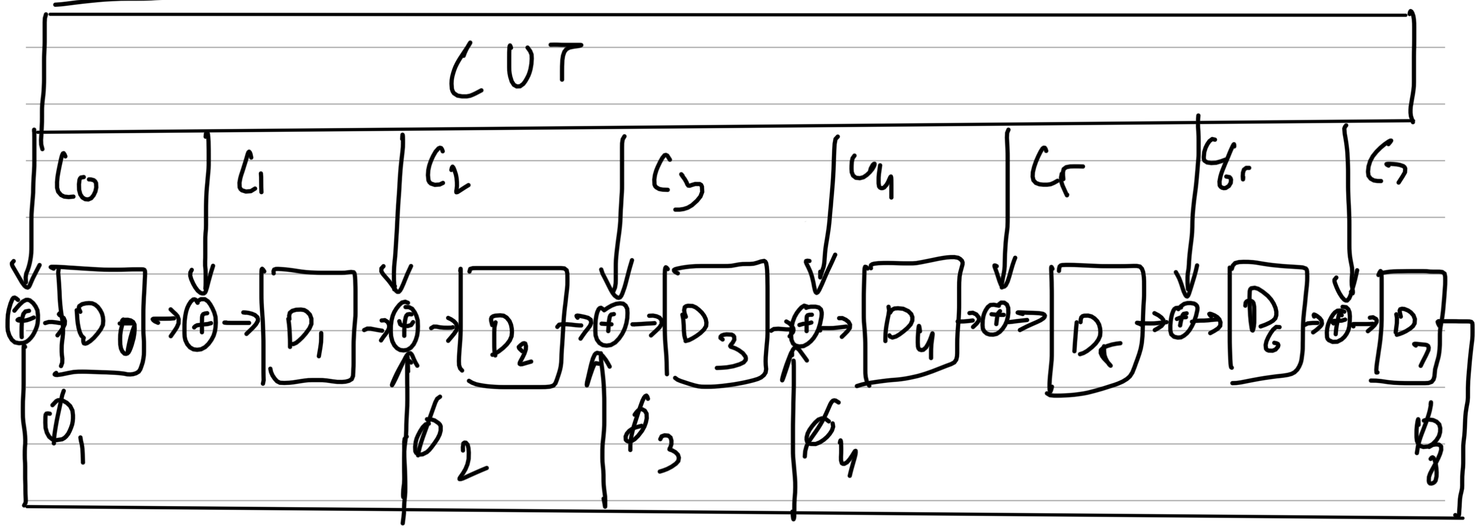
Cycle =

$$\begin{bmatrix}
1&1&1&1&1&1&1&1&0&0&0&0&1&0&1&1&1\\
1&1&1&1&1&1&1&0&0&0&0&1&0&1&1&1&1\\
1&1&1&1&1&1&0&0&0&0&1&0&1&1&1&1&0\\
1&1&1&1&1&0&0&0&0&1&0&1&1&1&1&0&0\\
1&1&1&1&0&0&0&0&1&0&1&1&1&1&0&0&0\\
1&1&1&0&0&0&0&1&0&1&1&1&1&0&0&0&1\\
1&1&0&0&0&0&1&0&1&1&1&1&0&0&0&1&1\\
1&0&0&0&0&1&0&1&1&1&1&0&0&0&1&1&0
\end{bmatrix}$$

(iii)




MISR :



Initial seed : 00000000

To find z7 z6 z5 z4 z3 z2 z1 z0

① 0111
1111
---
0111
0111
0111
0111
---
0101101

② 0011
1111
---
0011
0011
0011
0011
---
0010001

③ 0001
1111
---
0001
0001
0001
0001
---
0001111

④ 0000
1111
---
0000
0000
0000
0000
---
0000000

⑤ 1000
0111
---
1000
1000
1000
0000
---
0111000

⑥ 0100
0011
---
0100
0100
0000
0000
---
0001100

⑦ 1010
0001
---
1010
0000
0000
0000
---
0001010

⑧ 1101
0000
---
0000
0000
0000
0000
---

⑨ 1110
1000
---
0000
0000
0000
1110
---
1110000

⑩ 1111
0100
---
0000
0000
1111
0000
---
0111100

⑪ 0111
1010
---
0000
0111
0000
0111
---
0110110

⑫ 0011
1101
---
0011
0000
0011
0011
---
0010111

(13)

```
      0 0 0 1
      1 1 1 0
    ---------
      0 0 0 0
     0 0 0 1
    0 0 0 1
   0 0 0 1
  -----------
  0 0 0 1 1 1 0
```

(14)

```
      1 0 0 0
      1 1 1 1
    ---------
      1 0 0 0
     1 0 0 0
    1 0 0 0
   1 0 0 0
  -----------
  1 1 1 1 0 0 0
```

(15)

```
      1 1 0 0
      0 1 1 1
    ---------
      1 1 0 0
     1 1 0 0
    1 1 0 0
   0 0 0 0
  -----------
  0 1 0 0 1 0 0
```

(16)

```
      0 1 1 0
      0 0 1 1
    ---------
      0 1 1 0
     0 1 1 0
    0 0 0 0
   0 0 0 0
  -----------
  0 0 1 0 1 0 1 0
```

$$
\begin{bmatrix} z_0 \\ z_1 \\ z_2 \\ z_3 \\ z_4 \\ z_5 \\ z_6 \\ z_7 \end{bmatrix}
=
\begin{array}{cccccccccccccccc}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 \\
\end{array}
\begin{bmatrix}
1&1&1&0&0&0&0&0&0&0&0&1&0&0&0&0\\
0&0&1&0&0&0&1&0&0&0&1&1&1&0&0&1\\
1&0&1&0&0&1&0&0&0&1&1&1&1&0&1&0\\
1&0&1&0&1&1&1&0&0&1&0&0&1&1&0&1\\
0&1&0&0&1&0&0&0&1&1&1&1&0&1&0&0\\
1&0&0&0&1&0&0&0&1&1&1&0&0&1&1&0\\
0&0&0&0&0&0&0&0&1&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0
\end{bmatrix}
$$

```
d0   0000100000000 000 1110
d1       1001110001000 01000
d2         0101111000100 1010
d3           1011001001 1101 010 0
d4             00101111100 01001 00
d5               01100111100 01000 010
d6                 00101000100000 0000
d7                   00000000000 0 0 00 0 00
--------------------------------------------
D    0100 0110100001111 01001000
```

equivalent seq $\Rightarrow x^{20} + x^{17} + x^{15} + x^{14} + x^{13} + x^{12} + x^{8}$

$x^{6} + x^{5} + x$

given seq $= x^{8} + x^{4} + x^{3} + x^{2} + 1$

$$x^{12} + x^{9} + x^{8} + x^{2} + x$$

$$x^{8} + x^{4} + x^{3} + x^{2} + 1 \;\Big)\; \cancel{x^{20}} + x^{17} + \cancel{x^{15}} + \cancel{x^{14}} + x^{13} + \cancel{x^{12}} + x^{8}$$

$$x^{6} + x^{5} + x$$

$$\cancel{x^{20}} + x^{16} + \cancel{x^{15}} + \cancel{x^{14}} + \cancel{x^{12}}$$

$$\cancel{x^{17}} + x^{16} + \cancel{x^{13}} + x^{8} + x^{6} + x^{5} + x$$

$$\cancel{x^{17}} + \cancel{x^{13}} + x^{12} + x^{10} + x^{9}$$

$$\cancel{x^{16}} + \cancel{x^{12}} + \cancel{x^{11}} + x^{9} + \cancel{x^{8}} + x^{6} + x^{5} + x$$

$$\cancel{x^{16}} + \cancel{x^{12}} + \cancel{x^{11}} + x^{10} + \cancel{x^{8}}$$

$$\cancel{x^{10}} + x^{9} + \cancel{x^{6}} + \cancel{x^{5}} + x$$

$$\cancel{x^{10}} + \cancel{x^{6}} + \cancel{x^{5}} + x^{4} + x^{2}$$

$$x^{9} + x^{7} + \cancel{x^{4}} + \cancel{x^{2}} + \cancel{x}$$

$$\cancel{x^{9}} + x^{5} + \cancel{x^{4}} + x^{3} + \cancel{x}$$

$$x^{7} + x^{5} + x^{3} + x^{2}$$

$\therefore$ the final signature of MISR (8-bit) is

$x^{7} + x^{5} + x^{3} + x^{2}$